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UNITED KINGDOM
national remote sensing centre

SPOT Users Guide

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SPOT Users Guide

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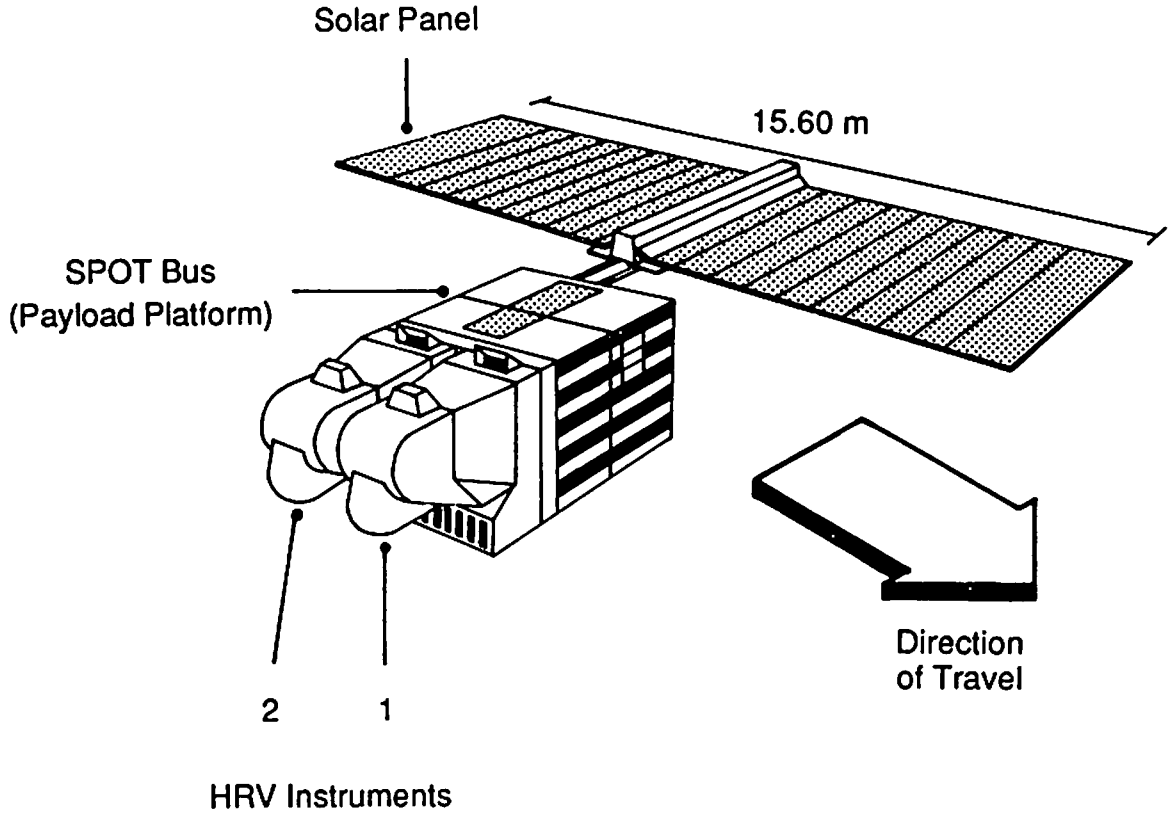
PREFACE

This document has been prepared to provide users of the National Remote Sensing Centre with information specifically on the SPOT system. It includes details on the satellite and its sensors, the ground segment and customer services available at the NRSC. A map series showing SPOT coverage worldwide is currently under development and will be released next year, in the meantime a map of the UK is provided together with a listing of imagery held by the NRSC. Subsequent issues of the SPOT Users Guide will be designed to facilitate the periodic update of details and archive listings. New or amended information will be supplied automatically to users as it becomes available, therefore please return the enclosed registration form if you wish to receive the updates.



General view of the SPOT satellite with solar array deployed.

CONTENTS

1. INTRODUCTION

1. INTRODUCTION

1.1 SPOT - 'Satellite Pour l'Observation de la Terre'

The French Government decided to undertake the development of the SPOT civil Earth observation programme in 1978. The SPOT system was conceived and designed by the French Space Agency, CNES (Centre National d'Etudes Spatiales) and is being undertaken in association with Sweden and Belgium (see Appendix 1 for a detailed breakdown of ownership).

The complete system comprises of both the orbiting spacecraft and an extensive ground segment for image reception and processing. These technical facilities are complemented by the SPOT Image marketing organisation which handles the worldwide promotion and sale of SPOT satellite imagery. This commercial, rather than experimental, nature is an important feature of the SPOT programme.

In addition, the SPOT satellite instrument package has several features new to space remote sensing, compared with previous systems such as Landsat. It is the first to include a linear array sensor and employ push-broom scanning techniques. It is also the first system to have pointable optics (i.e. the instrument can 'look' to one side or the other of the satellite ground track). Among the possibilities introduced by this facility is that of increased revisit coverage at intervals ranging from one to several days and the recording, during successive satellite passes, of stereoscopic pairs of images of a given area.

SPOT-1, the first satellite in the SPOT programme, was launched from Kourou in French Guiana on 22 February, 1986, onboard an Ariane launch vehicle. SPOT-2 is due to be launched in mid-1989 and SPOT 3 in 1990. Continuity of user service will be provided in the 1990s by a second generation of SPOT satellites; namely SPOT-4 and SPOT-5 (see Appendix 2).

The fine ground resolution, and unique viewing capabilities of revisit and stereoscopy make the SPOT system suitable for a wide variety of applications:-

- **Geology** - stereoscopic imagery at 1:50,000 facilitates the identification of terrain and the detection of geochemical and structural anomalies and is, therefore, a useful tool in the exploration of oil and mineral resources.
- **Agriculture and Forestry** - SPOT data can be used in land cover studies, in the forecasting of crop yields, and in the analysis of damage caused by natural phenomena, such as flooding.
- **Urban and Regional Studies** - the system can also be used by town planners who need to regularly monitor trends in land use, such as the urban/rural boundary.
- **Cartography** - the high resolution of SPOT images and the stereoscopic capability enables topographic maps to be produced at scales of 1:50,000 and even 1:25,000 in some cases. Such features are also useful in the updating of existing maps and in the production of maps of regions where none exist.

2. ORBIT AND COVERAGE

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2.1 ORBIT CHARACTERISTICS

The SPOT mission places several constraints on the satellite orbit:

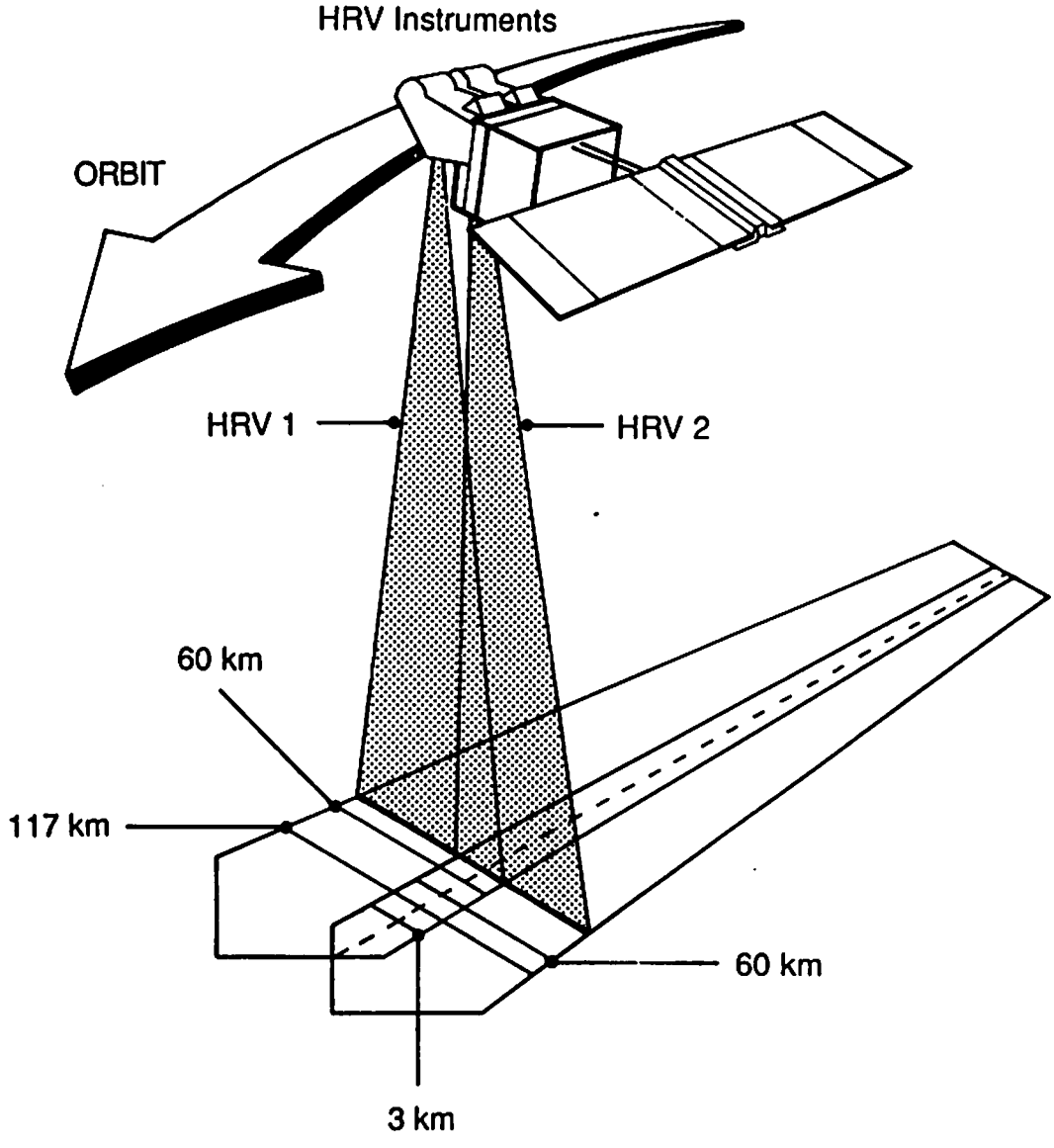
- For images of different locations to be suitable for comparison, they must be acquired from the same altitude. To meet this requirement the SPOT-1 orbit is **circular** (i.e. it has a constant altitude relative to the Earth's surface).
- The valid comparison of images of a given location acquired on different dates depends on the similarity of the conditions of illumination. Therefore, the orbital altitude and the inclination of the orbital plane were chosen to provide a **sun-synchronous** orbit.
- It is essential to achieve an observation cycle giving repeat access to any particular point at regular intervals. This requirement is met by choosing a **near-polar** orbit. Although the poles are not covered, the satellite can acquire data to latitudes of 81°, north and south.

SPOT-1 completes 14 5/26 revolutions per day at an altitude of 830 km (at the equator). In 26 days it thus makes a whole number of revolutions following one complete ground track cycle. To ensure that the satellite ground track covers every point on the Earth's surface during this cycle, the system has been designed so that the combined field of view of the two HRV imaging instruments is greater than the distance between two adjacent tracks. This is achieved using the so-called 'twin-vertical' (standard) viewing configuration in which the spacecraft ground track bisects the swath imaged by the two instruments (see Figure 1).

Table 1 — Orbit Details

Altitude (at equator)	830 km
Inclination	98.7°
Period	101.4 minutes
No. of Passes for Total Coverage	369
Repeat Period	26 days
No. of Passes per 24 Hour Period	14 5/26
Equator Crossing Time (descending node, June 15th)	10:30 am
55° N Crossing Time	11:34 am
Distance Between Tracks at the Equator	108.6 km
Distance Between Tracks at 55° N	62 km
Time Between Pass of Two Adjacent Tracks	5 days
No. of Tracks Between Two Successive Passes	26 tracks
No. of Tracks Between Two Successive Days	5 tracks

Figure 1 — Coverage Characteristics



In the twin-vertical configuration, each HRV acquires images of a 60 km wide strip. The combined field of view of the two HRVs is 117 km, including 3 km of sidelap. The maximum distance between adjacent ground tracks at the equator being 108 km, this configuration ensures complete coverage of the Earth in minimum time (26 days).

3. PLATFORM AND PAYLOAD

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3.1 OVERVIEW

The SPOT satellite consists of two parts: the SPOT 'bus', a standard multipurpose platform, and a payload.

The various subsystems of the **SPOT bus** perform the many housekeeping functions vital to the success of the SPOT mission. These functions include:

- precision control of the orbit;
- three-axis stabilisation;
- electrical power supply;
- onboard data handling ;
- housekeeping telemetry and command;
- monitoring and programming of the payload through an onboard computer with a memory which is loaded by ground control.

The SPOT bus design is compatible with a variety of Earth observation payloads and this versatility offers the possibility of launching other satellites of a similar type without incurring the development costs associated with creating a new platform.

The **SPOT payload** is mounted on one of the side panels of the bus and comprises of:-

- two identical but independent imaging instruments known as HRV's (from the French 'Haute Resolution Visible');
- two magnetic tape data recorders;
- an image telemetry package for data transmission to the ground.

3.2 THE HRV INSTRUMENT

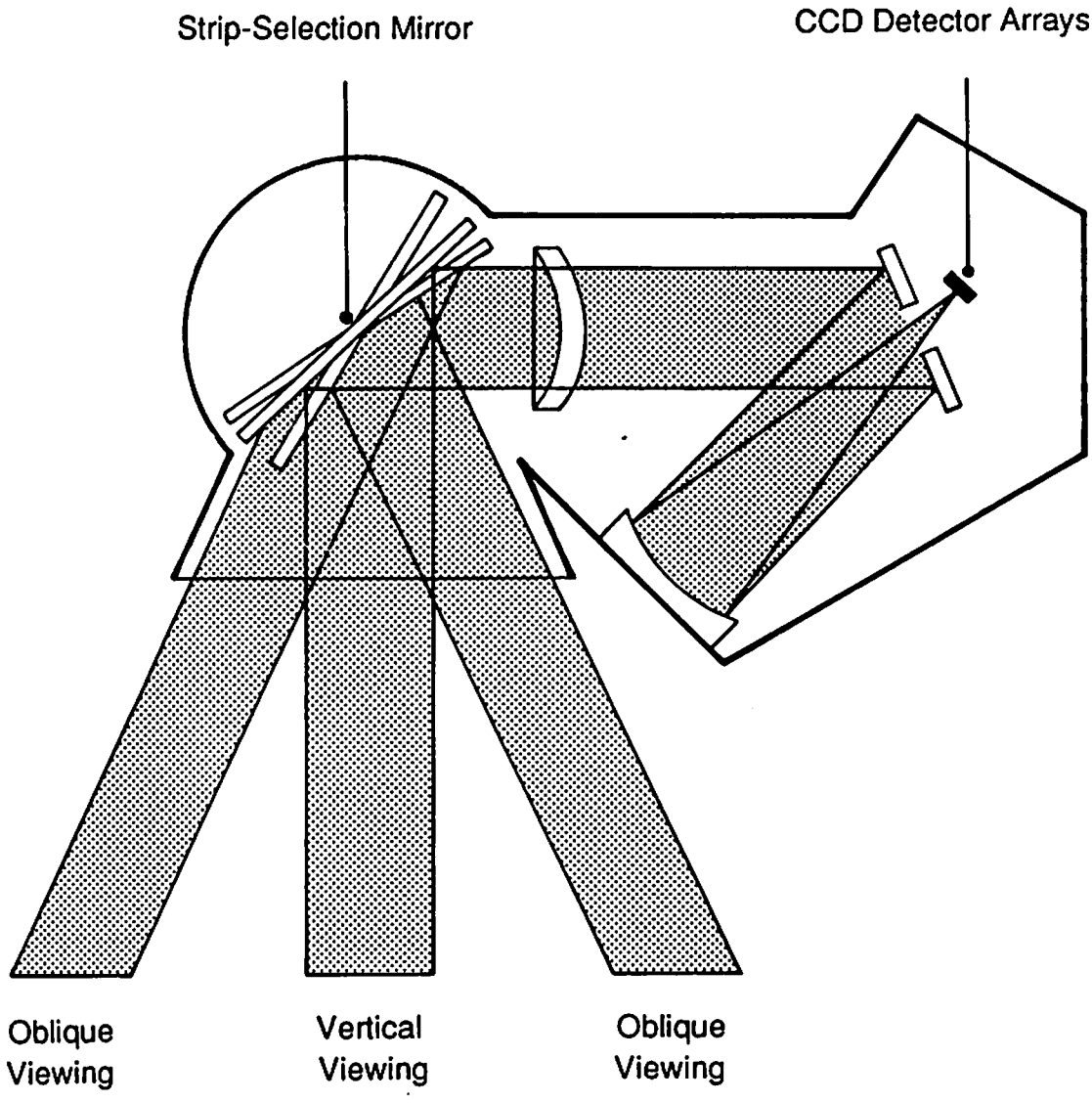
The HRV instrument (see Figure 2) is designed to operate in either of two modes, in the visible and infra-red portions of the spectrum:

- a **PANCHROMATIC (Pan)** or black and white mode corresponding to observation over a broad spectral band (0.51 to 0.73 μm). This mode is intended primarily for applications which require fine geometric detail;

- a **MULTISPECTRAL (XS)** mode corresponding to observation in three narrower spectral bands: green (0.50 - 0.59 μm), red (0.61 - 0.68 μm) and the near infra-red (0.79 - 0.89 μm). Together, these ensure improved spectral response to chlorophyll and specifically to the response peak in the green band, strong absorption in the red and a pronounced response in the near infra-red.

In the **panchromatic mode**, the HRV generates 6,000 points per line*, each point being separated by 10 m on the ground. Since the distance on the ground between successive lines is also 10 m*, the corresponding sampling interval (or pixel) is 10 m x 10 m. In the **multispectral mode,** each spectral band equates to 3,000 points per line*, the lines being separated by 20 m on the ground. In this case the distance between the lines is also 20 m, so the sampling interval is 20 m x 20 m.
(* — for nadir viewing).

Figure 2 — The HRV Instruments



The HRV instruments are large (folded) telescopes. Each is 2.5 m long and weighs 250 kg.

Light reflected or scattered by the surface is received by linear arrays of detectors in the focal plane of the HRV imaging instrument. The detectors are of the CCD (charge-coupled device) type, each elementary detector being only 13 x 13 µm in size. It is their function to convert incoming light into electrical signals.

Each CCD detector receives light from a narrow strip of the Earth, the width of the strip corresponding to the detector field of view (and hence to the instrument ground resolution). The electronics ensure that each detector receives light from its own narrow ground strip during the time required by the satellite to move forward 10 m (1.5 ms). This image acquisition technology, known as the 'push-broom' technique, overcomes the need for a mechanical scanning mechanism and its associated problems (see Figure 3).

The CCD linear arrays are arranged so that there are 6,000 detectors per scan line in the panchromatic mode. Given that each scan line corresponds to a swath of landscape perpendicular to the ground track and that each detector images a 10 m wide portion of that line, the total swath width is 60 km.

Figure 3 — The 'Push-broom' Technique

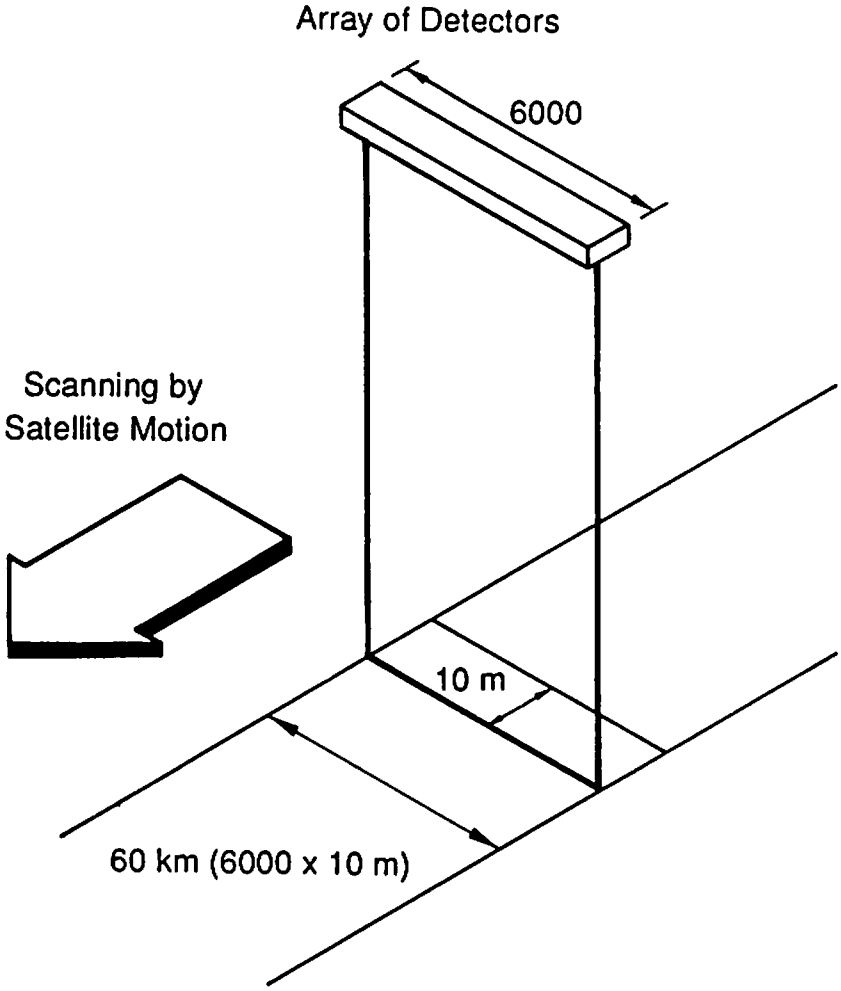


Table 2 — Characteristics of the HRV Instrument

Characteristics of the HRV Instrument	Multispectral mode	Panchromatic mode
Spectral bands	0.50-0.59 µm 0.61-0.68 µm 0.79-0.89 µm	0.51-0.73
Instrument field of view	4.13°	4.13°
Ground sampling interval (nadir viewing)	20 m x 20 m	10 m x10 m
Number of pixels per line (nadir viewing)	3,000	6,000
Ground swath width (nadir viewing)	60 km	60 km
Pixel coding format	3 x 8 bits	6 bits DPCM
Image data bit rate	25 M bits/s	25 M bits/s

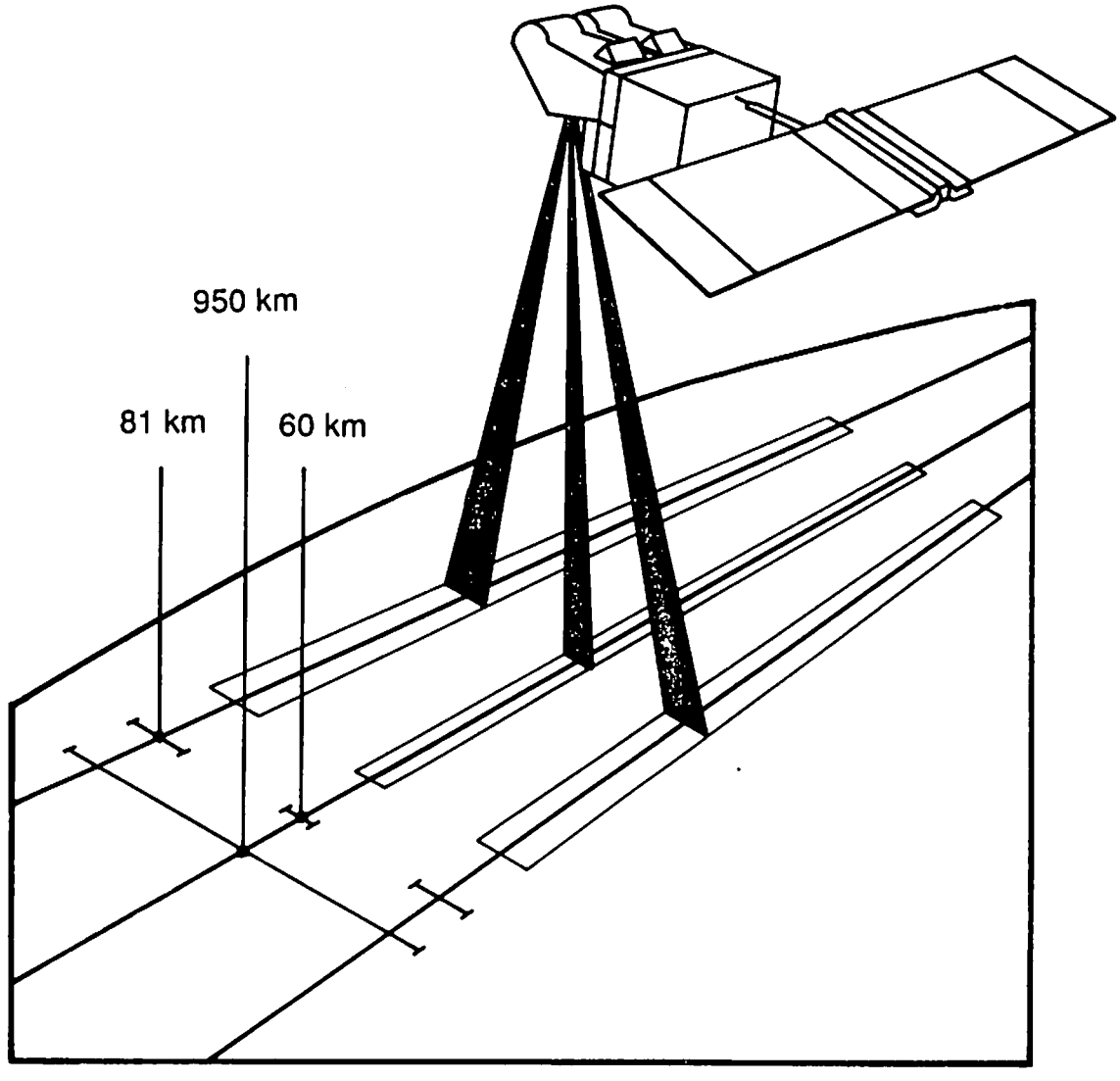
3.3 THE VIEWING CAPABILITIES OF THE HRV INSTRUMENT

The SPOT satellite introduces a major innovation in that the viewing direction of each HRV can be varied through ± 27° relative to the nadir and to the orbital plane (in steps of 0.6° - 45 steps), with each step of tilting equalling approximately 9 km on the ground and each full degree of tilting about 15 km. This results in two major advantages:

- **excellent revisit capability**
- **the possibility of acquiring stereo pairs**

The HRV entrance mirrors, also known as 'swath selection mirrors' (SSM's), are steerable by ground control. Therefore, it is possible to position them, as required, to observe regions of interest not necessarily vertically beneath the satellite. This gives rise to the concept of an 'observable corridor' extending 950 km (475 km on either side of the satellite ground track) as shown in Figure 4. The width of the strip varies between 60 km for near-nadir viewing and 81 km for extreme oblique imagery (viewing angles of ± 27°). The program of observations to be made is controlled by the satellite's onboard computer. A sequence of recorded images may include both modes of instrument operation (multispectral or panchromatic mode) and changes in the viewing direction of each instrument.

Figure 4 — The 'Observable Corridor'



3.3.1 Revisit Capabilities

If the satellite's instruments were only capable of nadir viewing, the revisit frequency for any given region would be 26 days. This interval is unacceptable for the observation of phenomena evolving on timescales ranging from several days to a few weeks, especially where cloud cover hinders further the acquisition of usable data.

However, with SPOT, the capability for off-nadir viewing during satellite passes in the vicinity of the area of interest considerably increases the revisit possibilities.

During the 26-day period separating two successive nadir satellite passes over a specific point on the Earth's surface, the programmable steering capability of the instruments allows the area to be observed on a number of different passes, e.g. seven on the equator and eleven occasions at a latitude of 45° (see Figure 5a).

For example, if the day on which the satellite first passes vertically over the point of interest is represented by D, then the other days on which the same point can be observed are as illustrated in Figure 5b. Thus, regions can be imaged on dates separated alternately by one and four (occasionally five) days. The possibility of obtaining image pairs on successive days is of considerable interest for the monitoring of dynamic and rapidly changing environmental phenomena and for stereoscopic analysis. Viewing on successive days should also improve the chances of obtaining cloud-free imagery over countries with weather conditions that do not usually provide long periods for optimum imaging.

Passes on Days:

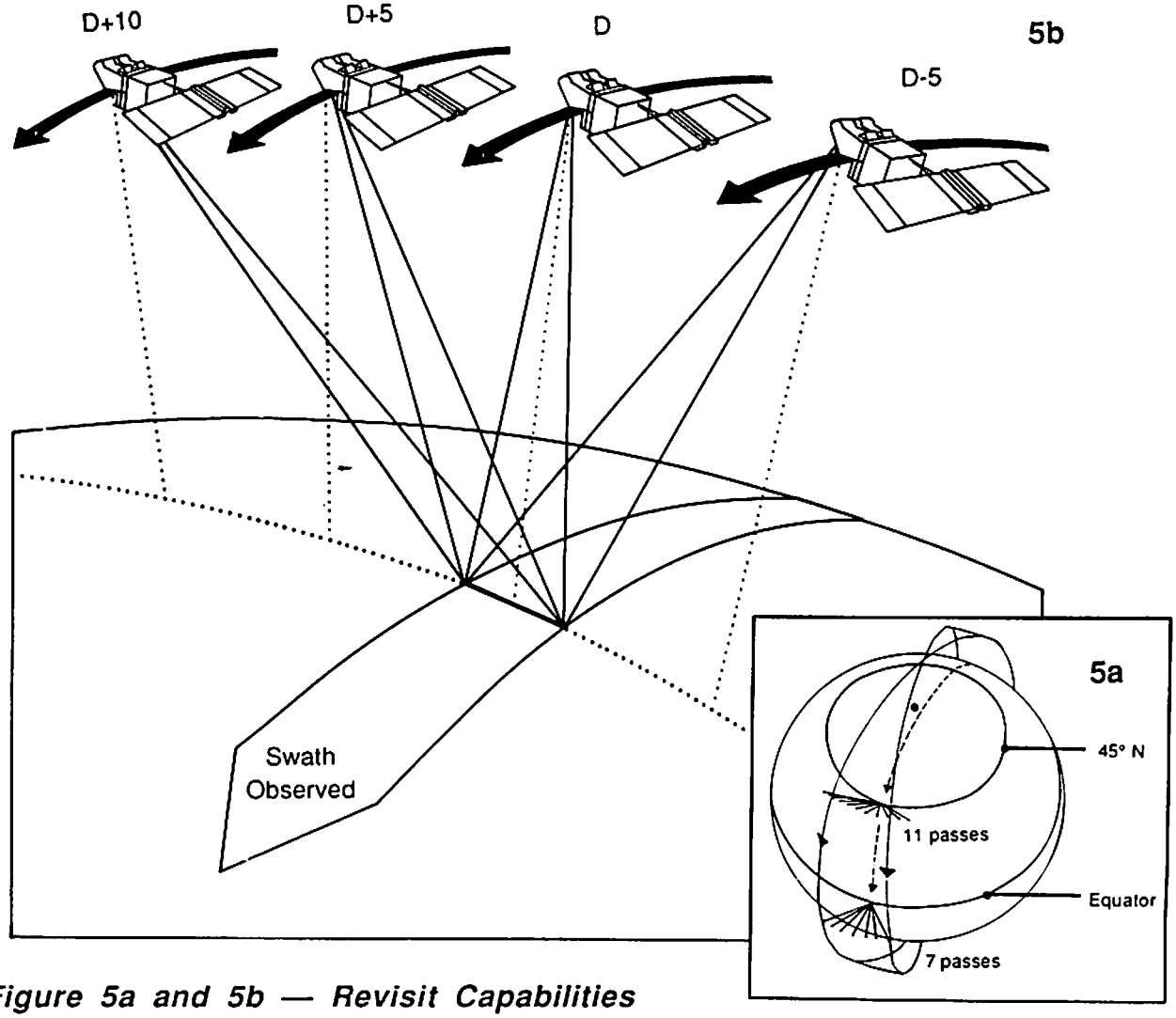


Figure 5a and 5b — Revisit Capabilities

3.3.2 Stereoscopic Viewing Capabilities

Another important capability offered by off-nadir viewing is that of recording stereoscopic pairs of images of a given scene, i.e. images acquired at different angles during successive satellite passes (see Figure 6).

It has been shown that two observations can be made on successive days such that the two images correspond to pointing angles on either side of the vertical. In such cases, the ratio between the observation base (or distance between the two satellite positions) and the satellite's height is, for instance, 0.75 at the equator and 0.50 at a latitude of 45°, and is therefore sufficient to permit stereo viewing.

Compared with stereopairs obtained from aerial photography, the main features of SPOT stereo images are as follows:

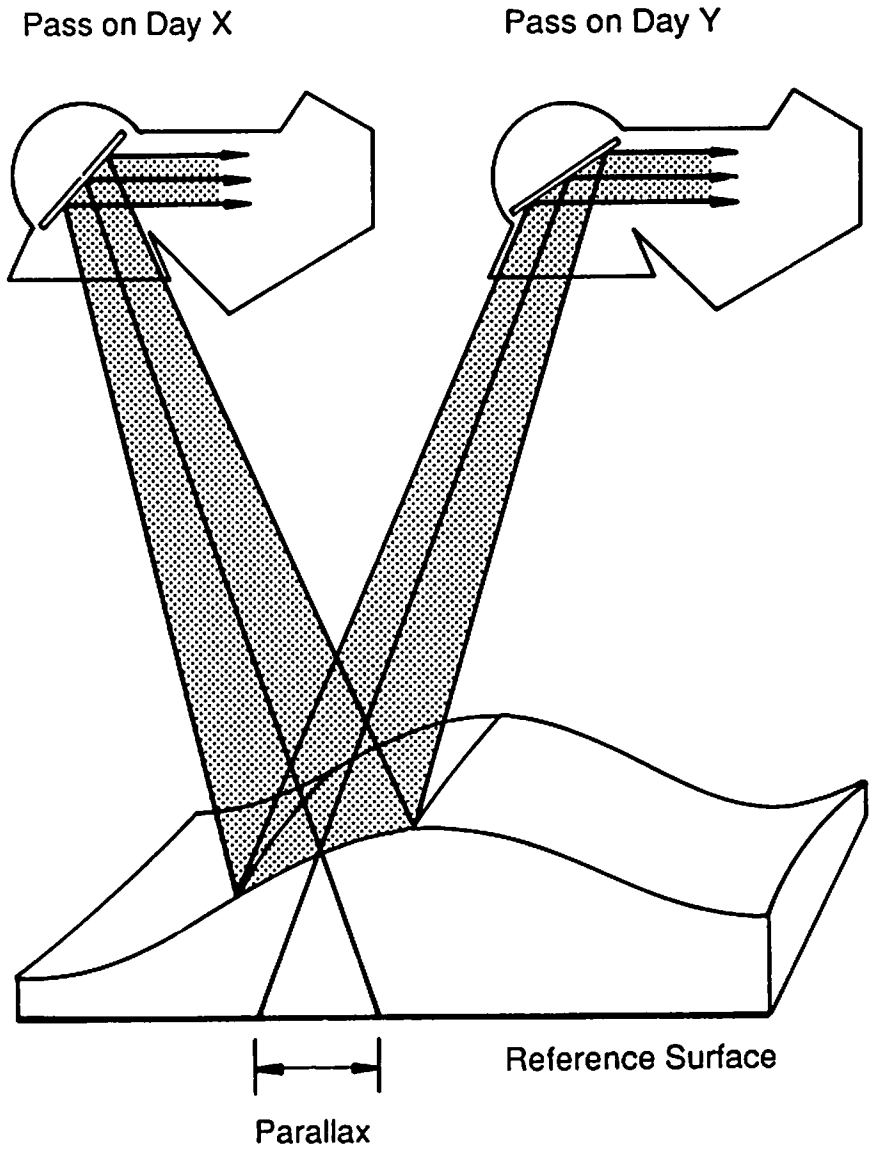
	SPOT	Aerial Photography
Scene size	large format (60 km x 60 km)	small format (usually 5 km x 5 km or 10 km x 10 km)
Scales	1:25,000 - 1:400,000	often 1:10,000 - 1:50,000 range ≤ 1:5,000 - 1:100,000
Projection	cylindro-conic*	conic
Homogeneity	high uniformity of projection and viewing conditions	low uniformity especially across mosaiced photographs

* Special attention is required to maintain the observation base under the stereoscope perpendicular to the satellite ground track and to ensure that the viewing axis remains as close as possible to the vertical.

The main applications for stereoscopic imagery are in photogrammetry for cartographic purposes and photo-interpretation for geological, geomorphological and hydrological studies. It is now possible to:

- compile topographic maps with uniform vertical contour interval of 20 to 50 m.
- perceive large man-made structures and gross vegetation features.
- compile directly digital terrain models.

Figure 6 — Stereoscopic Capabilities



4. THE GROUND SEGMENT

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4.1 ORGANISATIONAL STRUCTURE

A number of organisations are involved in the exploitation of the SPOT operational system. The major partners are CNES (Centre National d'Etudes Spatiales), the IGN (Institut Géographique National), SPOT Image and the Swedish Satimage company.

As the satellite operator, CNES is at the centre of the organisational structure. To ensure smooth running, CNES set up dedicated facilities at the Toulouse Space Centre. CNES is directly responsible for:-

- orbit maintenance and payload programming (i.e. programming of the HRV imaging instruments and the on-board tape recorders).

- reception and preprocessing of image telemetry received at Toulouse (these functions being performed jointly between CNES and the IGN).

The CNES entity established to handle these duties is known as the 'Exploitation of Remote Sensing Satellites Division'. The facilities managed by this division include:-

- the Mission and Operations Control Centre (MOCC);
- the Space Imagery Receiving Stations (SRIS);
- the Space Imagery Rectification Centres (CRIS).

4.2 MISSION AND OPERATIONS CONTROL CENTRE (MOCC)

The SPOT MOCC is composed of three sections and all of them are located at Aussaguel, near Toulouse. As a whole they are responsible for SPOT operations involving Telemetry and Tracking, payload programming and the coordination of ground facilities (See Figure 7). The three sections are:

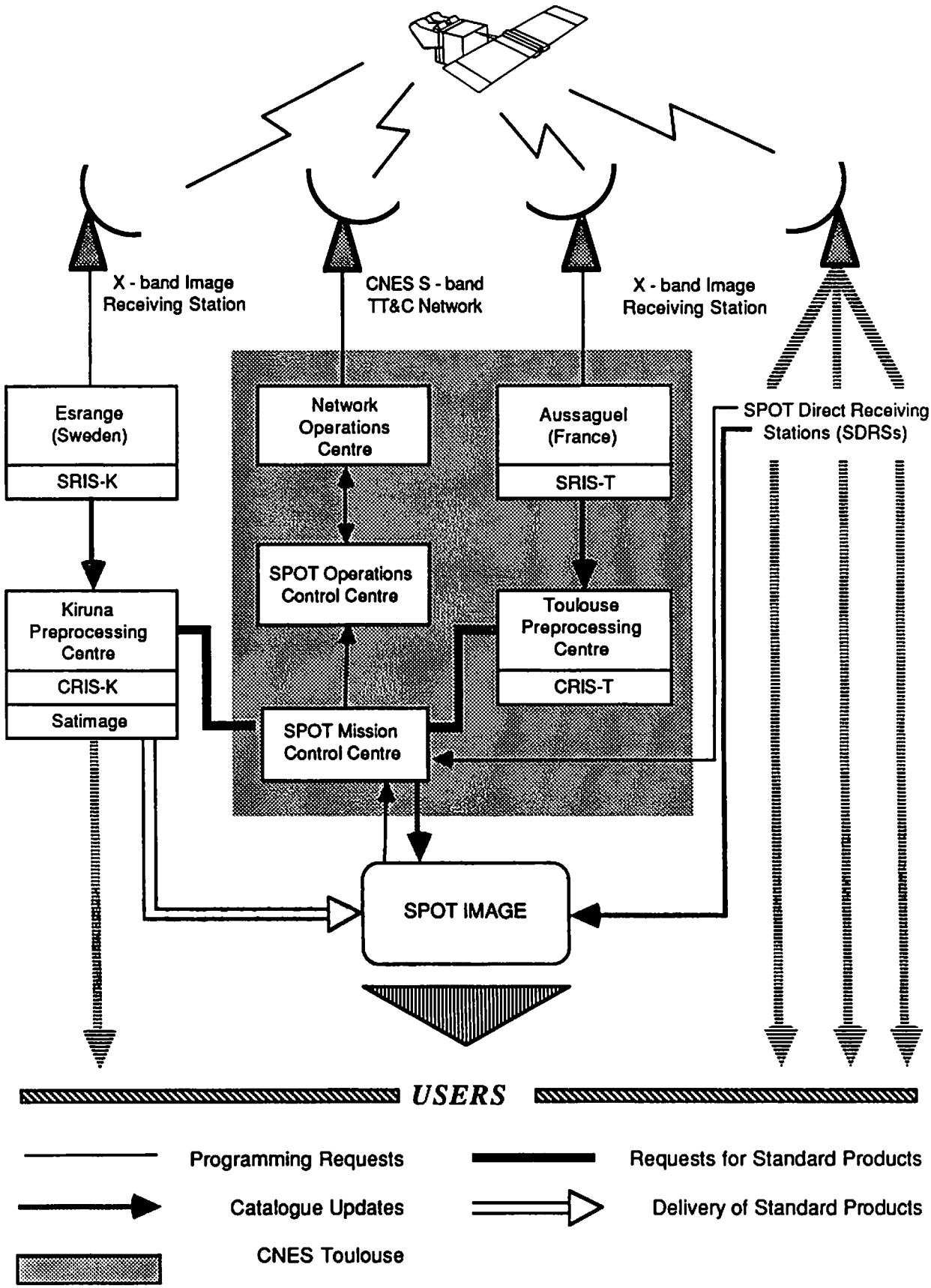
- **Network Operations Centre**
  The functions of the control station, which operates in the S-band (2 GHz), are to uplink satellite commands, perform satellite tracking and receive satellite housekeeping telemetry when the spacecraft comes into range.

- **Operations Control Centre**
  Interfaces directly with the ground station. This section analyses telemetry and tracking data and defines manoeuvres to maintain the satellites' orbit and attitude within the specified tolerances; it also generates the corresponding commands.

- **Mission Control Centre**
  Payload programming comes under the responsibility of the Mission Control Centre which centralises and analyses programming requests from SPOT Image and stations outside France. If these requests are accepted (SPOT Image arbitrates if certain requests cannot be reconciled), this section sends them to the Operations Control Centre for uplinking to the satellite.

  Preprocessing (at Toulouse and Kiruna) of incoming data from the Space Imagery Receiving Stations (SRIS) is also co-ordinated by this section.

Figure 7 — SPOT Control and Data Reception



4.3 DATA ACQUISITION

The basic unit for segmenting the image data stream at the ground receiving and preprocessing stations is the 'scene'. This corresponds to image data for an area 60 km in length (along the ground track) and 60 to 81 km in width (in the cross-track direction), depending on the instrument viewing angle. Each scene is referenced to a pre-determined grid (called the 'SPOT Grid Reference System' or 'GRS') applied to the Earths' surface as well as by latitude and longitude (for further information on GRS see Appendix 3).

4.3.1 Space Imagery Receiving Stations (SRIS)

Data are received at two SRIS (from 'Station Reception des Images Spatiales') stations: one at Aussaguel, near Toulouse (SRIS-T) and one at Esrange, near Kiruna, Sweden (SRIS-K). These stations receive data transmitted by the spacecraft as it passes over the north polar region, Europe and North Africa, and also data acquired over other areas and stored on the two onboard tape recorders. There are two groups (ascending and descending) of two or three passes each day over the Toulouse station and significantly more over the Kiruna station because of its higher latitude; each pass lasts up to 800 seconds. Together, Toulouse and Kiruna have a receiving capacity of 500,000 images per year.

The ground stations can receive satellite telemetry only when the satellite is within a 'range of visibility' approximately 2500 km in radius. This corresponds to a satellite elevation of at least 5 degrees above the horizon.

4.3.2 Space Imagery Rectification Centres (CRIS)

Each SRIS is associated with a preprocessing centre or CRIS (from 'Centre de Rectification des Images Spatiales'). The basic image data received on High Density Digital Tapes from the SRIS must be processed in a number of different ways to make them more directly usable. The correction processes applied include radiometric corrections, taking into account the calibration factors for the detectors and the optical and telemetry systems, and geometric corrections to allow for the viewing conditions, such as viewing angle, Earth rotation etc.. The CRIS is responsible for carrying out these and additional standard image data processing operations as well as for archiving raw data received by the SRIS. The equivalent of 700 scenes will be archived every 24 hrs at both Toulouse (CRIS-T) and Kiruna (CRIS-K).

4.3.3 Processing Levels and Products

The additional processing operations are divided into several different levels of sophistication:

Level 1: Basic radiometric and geometric corrections (this level does not involve ground control points or satellite attitude restitution data).

Level 1a: Essentially a 'raw' data level, apart from the normalisation of CCD detector response in each spectral band. Data concerning both viewing geometry and inter-band and absolute calibration factors may be supplied for use in subsequent processing. There is no geometric correction, hence, the number of picture elements in this data is 3000 x 3000 for multispectral and 6000 x 6000 for panchromatic data.

This level is of particular importance for applications involving stereoplotting and basic radiometric studies.

Level 1b: Involves full radiometric (desmearing) and limited geometric corrections taking into account systematic distortions due to system effects; for instance: rotation and curvature of the Earth, viewing angle and smearing due to orbital motion. The absolute location accuracy for vertical viewing is 1500 metres (rms error) while internal distortion is less than 10^{-2}. Radiometric correction taking care of missing information is also carried out at this level. If a maximum of four lines have no information, that space is replaced by interpolated information from adjacent lines. The same procedure is used if up to four detectors are not functioning. If more than four lines or columns are missing, that space is left with a digital value of zero.

At this level multispectral data contains between 3200 and 4250 pixels per line and 3000 lines, and panchromatic data between 6400 pixels and 8500 pixels per line and 6000 lines.

This is the basic preprocessing level for photo interpretation and thematic analysis. Stereoscopic pairs, with B/H ratios depending on instrument viewing angles, are also available at this level.

Level 2: This is a precision processing level, which in addition to Level 1b radiometric corrections, calls for bidirectional corrections on the basis of 6 to 9 ground control points (GCPs) per scene. The image is thus rectified according to a given cartographic projection, such as conformal Lambert, transverse Mercator, oblique equatorial, polar stereographic, polyconic. However, Level 2 does not take account of distortions due to terrain relief. This means that the closer the viewing direction to the vertical and the less pronounced the relief, the more accurate the final product. The location accuracy for vertical viewing is 50 m (rms error), provided that the highest point in the scene does not exceed the lowest by more than 1250 m. In the case of oblique viewing at the maximum angle of (27°), this specified accuracy can still be met, provided maximum elevation less minimum elevation does not exceed 170 m. Film reproductions of Level 2 data are oriented with geographical north aligned with the Y-axis of the film, which generally means that the image borders are not parallel to the sides of the medium.

Level 2a: This product corresponds to Level 2 precision processing, but can be implemented without the use of map GCPs. The image is rectified into a specified cartographic projection but does not match the accuracy of standard Level 2 products. However, a simple translation in X and Y allows the image to be co-registered with a map in the same projection within the Level 2 accuracy (30 m).

Level S: This level of preprocessing involves scene rectification based on GCPs, ensuring registration with another scene used as a reference to within 0.5 pixels, given that the two registrations are made with approximately the same viewing angles. A maximum of 0.6° difference in viewing angles is permitted. The reference scene is of Level 1b or 2, and is

registered from the same satellite track as the scene to be treated. The variation in elevation within the scene should not exceed 300 m to reach the specified accuracy. If the above mentioned restrictions are not met, the image correction can still be carried out, although the accuracy will not meet the specified 0.5 pixels.

Level S products are intended primarily for multidate studies.

Special Products:

- a Multispectral and Panchromatic image merged (XS + P). The result is a multispectral image with a ground resolution of 10 m.
- scenes located anywhere along the satellite track.
- two-scene mosaics along track. Two SPOT scenes are assembled in the North — South direction creating a 120 km continuous image.
- four scene mosaics (bi-HRV). Consists of a bi-scene (bi-HRV) assembled over 120 km in the North — South direction. The result is a homogeneous area of 117 x 120 km representing four SPOT scenes.

4.3.4 SPOT Direct Receiving Stations (SDRS)

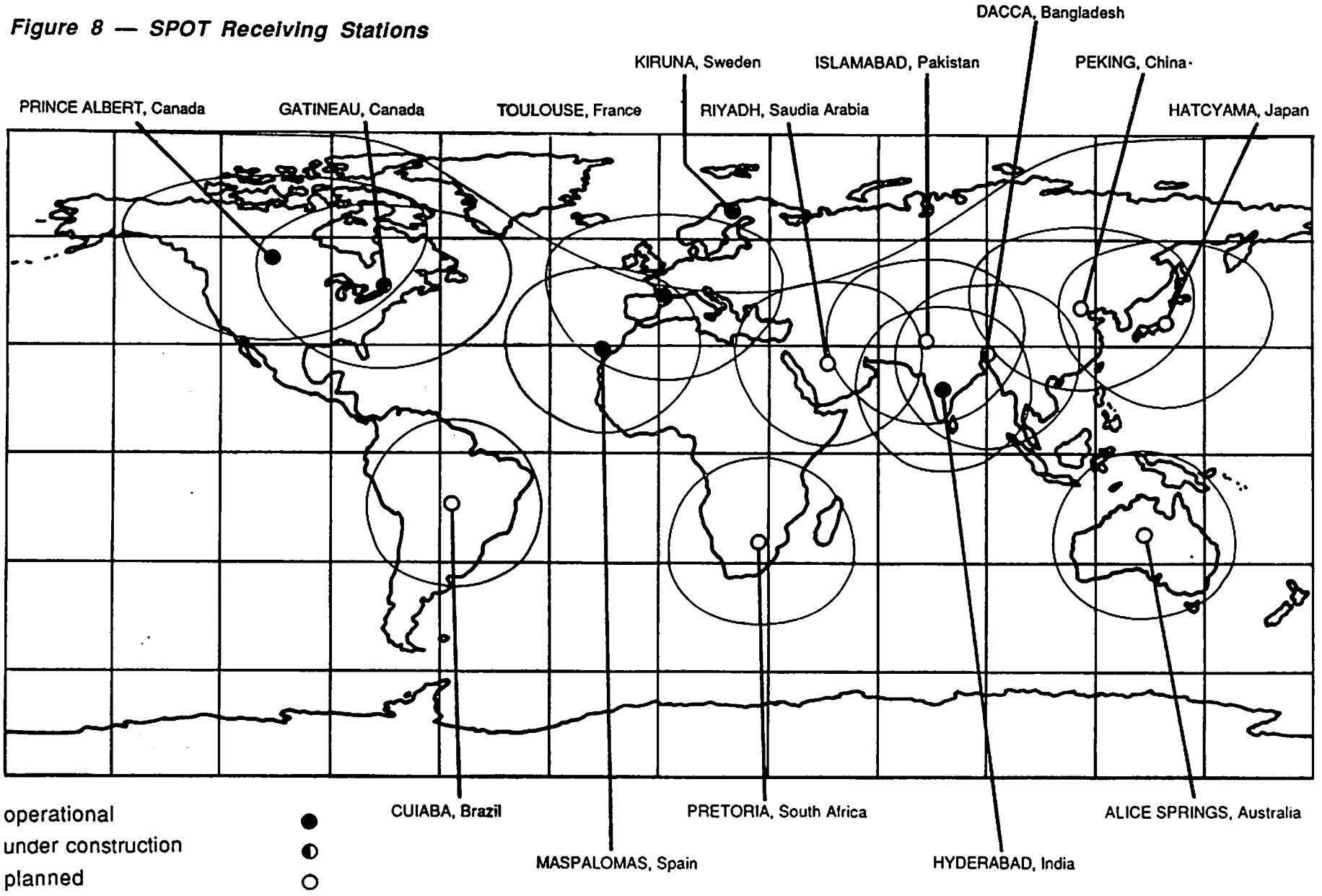
The exploitation of the SPOT system is based on two networks of X-band image receiving stations. The first, known as the 'central network', consists of the two SRIS stations and associated CRIS centres at Toulouse and Kiruna. The second, which may be termed the "decentralised network", consists of Direct Receiving Stations located throughout the rest of the world (see Figure 8).

Briefly, a Direct Receiving Station undertakes the following activities:-

- receives and archives image data relating to its own coverage area;
- distributes SPOT data in the country in which it is located;
- makes data available to SPOT Image for distribution to the rest of the world;
- supplies SPOT Image with the necessary information for updating the image catalogue (see Section 4.4.3).

An important difference between the two networks is that Toulouse and Kiruna can receive data from all over the world by using the onboard recorders and the recorder-playback telemetry mode, whilst the Direct Receiving Stations can only receive image telemetry corresponding to 'direct' mode imaging, i.e. data acquired while the satellite is within range of the station (approximately 2500 km radius). Each SDRS manages its own coverage area. Thus, for each pass, the station is responsible for selecting the areas to be imaged and the type of data to be acquired.

Figure 8 — SPOT Receiving Stations



4.4 DATA DISTRIBUTION

4.4.1 SPOT Image

One of the most innovative features of the SPOT programme is the underlying philosophy; ***SPOT is an operational and commercial remote sensing system.*** Operation is scheduled for around twelve years, providing continuity of service and enabling SPOT users to confidently develop their applications programmes into the 1990s. SPOT Image, set up on 1 July, 1982, was the first commercial company in the world created specifically to market and distribute data and products returned by Earth resources remote sensing satellites. As the link between SPOT users and the SPOT system, its main objectives are to:

- inform users of data acquired, archived and available from the French and foreign stations;
- distribute standard data products as produced at the Toulouse CRIS;
- produce and distribute custom-made data products and services derived from the standard products;
- provide advice, education and consultancy as required;
- provide users with access to data processing equipment.

4.4.2 Distribution Network

To promote the SPOT system and develop the market for SPOT data, SPOT Image has signed commercial agreements with a number of distribution centres throughout the world. Each organisation, whether public or private, is already established in the field of remote sensing and is responsible for the promotion and marketing of SPOT images in their respective countries. (For a complete list of SPOT distributors, see Appendix 4). Due to the special demands of the market, distribution in the U.S. is handled by SPOT Image Corporation (SICORP), a wholly owned subsidiary of SPOT Image based in Washington D.C.. A similar function is performed in the Scandinavian countries by Satimage which is a subsidiary of the Swedish Space Corporation.

4.4.3 Image Catalogue

SPOT Image operates a database known as the SPOT Image Catalogue. This contains comprehensive and up-to-date information on all the available image data, i.e. on all images received and archived by each station worldwide. The catalogue system is fully computerised and is operational 24 hours a day, 365 days a year. It contains, for each scene, information on the following criteria: location (geographical co-ordinates, orientation etc.), operating conditions (spectral mode, viewing configuration and angle, stereopairs etc.), scene identification (SPOT Grid Reference number, date), image quality (cloud cover) and related archived products already available.

Users access the Toulouse-based Catalogue by data transmission networks such as Transpac, Euronet, Tymnet, Telenet, Datapac, etc.. The user simply enters a password, then sends through programming requests, general enquiries and other orders and messages. The recorded messages are read out daily and the replies are returned to the user. Each SPOT distributor has the necessary facilities required to access the catalogue rapidly. Alternatively, information can be requested by post, telephone and telex or via electronic mail systems.

4.4.4 Image Acquisition

When an image is not available from the archives or if a user wishes to acquire imagery of a specific date, a programming request can be forwarded via the SPOT Image catalogue system or one of the Direct Receiving Stations, or by contacting a SPOT Image distribution centre.

5. NRSC CUSTOMER SERVICES

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5.1 THE NATIONAL REMOTE SENSING CENTRE

As the UK's interest in remote sensing expanded in the late 1970s it led to the formation of the National Remote Sensing Centre (NRSC) in April 1980. The NRSC serves as a national centre of expertise in remotely sensed data processing with a primary role to introduce new users to satellite imagery and to demonstrate how the data can be used for a variety of applications. The main objectives of the NRSC are as follows:-

- to supply satellite remote sensing data and imagery to order from any organisation, but primarily UK based companies, government departments, academic establishments and individuals;
- to assist British industry in its remote sensing activities in the UK and overseas;
- to provide facilities for the research into and the development of image processing, analysis and interpretive techniques;
- to act as a focal point for the development of remote sensing techniques and their applications; and
- to provide education and training facilities in remote sensing.

In the UK there are two organisations authorised to act as distributors of SPOT data, namely the National Remote Sensing Centre and Nigel Press Associates (NPA). To avoid duplication of effort the NRSC concentrates on the supply of UK data, as part of its long term policy to establish archives of UK satellite data. However, if NRSC customers require non-UK data, it will be acquired to order from SPOT Image.

5.2 SERVICES AVAILABLE AT THE NRSC

The NRSC makes available a range of services to any user (or potential user) of remote sensing data. These can broadly be divided into three categories as follows:

[a] **User Services** (provided free)
- information bureau and general enquiry service
- remote sensing library (including loan system)
- data search and acquisition service
- image browse facilities (for user assessment of UK satellite coverage)
- general applications advice
- remote sensing publications
- educational visits to the NRSC
- comprehensive SPOT UK archive

[b] **Image Analysis Systems** (for hire - by the hour)

[c] **Supply of Products** (to customer's order)
- digital data tapes
- photographic products
- associated products (maps, etc.)
- general interest products

5.3 ORDERING PRODUCTS

The NRSC supplies two main types of image products - either in digital formats (computer compatible tapes) for users with their own image processing facilities or as a comprehensive range of photographic products.

One of the first steps to take in ordering any product is to ascertain if the imagery of your particular area of interest is held within the NRSC satellite archive - as this affects the cost of the product and delivery times. Up-to-date listings of the NRSC's archives are available on request. If the required imagery is not held in the archive, the NRSC can advise on the best course of action to acquire the data and in many cases perform the necessary administrative tasks to acquire the data.

Terms of Business

The following terms of business at the NRSC apply:-

1) Written orders are required giving despatch and invoice addresses, if different.

2) Orders will only be accepted in writing by letter or telex.

3) Orders should provide adequate information (see Sections 5.3.1 and 5.3.2).

4) All products despatched or collected will be invoiced in accordance with the current price list.

5) All bills for products and services sold to UK organisations are subject to VAT at current rates, as price lists are generally ex-VAT.

5.3.1 Digital Data

CCTs are supplied on 9 track 6250 bpi (where applicable) or 1600 bpi phase encoded industry compatible 3600 ft tape. Two format types are available:

[a] original ground station format
[b] the standard RAE format, where the data are converted to a universal format

When digital type of data you should provide the following information:

- **column/row** - see SPOT coverage maps and GRS information
- **location** - if column/row not known, you should provide as much location information as possible (grid co-ordinates etc.), including a map if available, to ensure the correct scene is ordered.
- **date(s)** - if known, or provide an indication of best season for application or state a general requirement, such as most recent or best cloud-free scene
- **sensor mode** - Panchromatic (PAN) or Multispectral (XS)
- **tape format** - standard RAE format or original ground station format

5.3.2 Photographic Products

The procedure to transfer the data from the CCT to a photographic master is known as film writing. Photo products can be generated from any scene within the NRSC archive, or as specially processed data from the image analysis systems (e.g. classified scenes or non-standard enhancements) or from the users own data tapes.

If you require imagery for a scene not held in the NRSC archive, you can either order the digital data through the NRSC and ask for the photographic products to be generated or request the NRSC to purchase photo products directly from SPOT Image. All these options have different quality, cost and royalty charge implications, which you should discuss with NRSC staff before placing an order, to identify the optimum method of image acquisition to best suit the requirements of your task.

A comprehensive range of standard photographic products can be prepared from 240 mm black and white or colour masters. Standard prints are available at scales of 1:500,000, 1:250,000 and 1:100,000.

When ordering this type of data you should provide the following information:

to identify the data - follow the points for digital data outlined above

to identify the required final product -

- **black and white** (for XS, specify band number) or **colour**
- **format** - print, film transparency (positive), or film negative
- **scale** - precise scale, final size (only variable for prints), or enlargement factor
- **number of copies**

A SPOT Products Price List is included in the Appendices

5.3.3 General Interest Products and Promotional Materials

Over the years the NRSC has produced a range of general interest and educational products, including posters, prints, slide sets and videos. These are available for sale at the NRSC or through authorised distributors. Further details and a catalogue are available on request.

The NRSC also distributes a number of promotional materials, free of charge, to any interested organisation or individual.

- a brochure
- a data users guide
- an introductory guide to the NRSC
- a general interest products catalogue
- a quarterly newsletter
- a series of fact sheets

To obtain maximum benefit from this service you are advised to complete and return an NRSC mailing-list form — you will then be kept informed, through the NRSC Newsletter or other mailings, of any recent developments.

5.3.4 Commercial Confidentiality

On special occasions some customers request that their orders should be treated as confidential material, as it might be of value to a competitor. The words **'COMMERCIAL-IN-CONFIDENCE'** should be typed at the top of all such orders and accompanying documents.

This will invoke procedures to ensure that no competitor, including one that is ordering similar or identical material, can become aware of the original transaction. COMMERCIAL-IN-CONFIDENCE work may incur additional expense if it is necessary to substitute NRSC contract staff with intramural effort.

5.3.5 Copyright

All products supplied by the NRSC are subject to **Crown Copyright**. Customers wishing to reproduce from photographic or digital material supplied by the NRSC are required to notify the NRSC Manager of their proposals.

In addition, **SPOT Copyright** applies to all SPOT data, including a wide range of value-added products. SPOT data may not be disseminated in any form without the written consent of the copyright holder and payment of the appropriate royalty fee. SPOT data is defined as any signal transmitted and

recorded on any suitable medium and processed by any method, which does not significantly modify the form of such data by the use of data external to the acquisition system.

The following general points should be noted:

- the Centre National d'Etudes Spatiales (CNES) is the sole distributor of copyrights to SPOT data. The products marketed by SPOT Image are developed on the basis of such data;
- all orders for SPOT data should be processed through an authorised distributor;
- the purchaser shall only use the products for their own purposes and shall not, without the prior written consent of SPOT Image, make such products or reproductions available to a third party. Marketing and reproduction are subject to approval by SPOT Image;
- the purchase of a SPOT image confers a non exclusive right for private use with the buyer;
- up to a total of nine copies (in any format — CCT, negative, print, etc.) can be made of the original master for private or internal use;
- authorisation for collective use of products copies within groups of organisations governed by various statutes, such as national research councils, university departments, affiliate companies, etc. can be obtained from SPOT Image;
- publications of SPOT data and products in books, or periodicals on films, videos, posters or data bank transfers must have the prior consent of SPOT Image and may be subject to copyright royalties;
- all hardcopy products must display a copyright note, i.e. "© CNES nn", where nn is the year of the original data.

Complex copyright situations will be evaluated by SPOT Image on a case-by-case basis.

No copyright royalty will be due in the following cases:-

- reproduction of SPOT data and derived products in the form of incidental pictorial illustrations and related to a text when such material is reproduced by way of proceedings of symposia, seminars or congresses and for research reports or thesis. A copyright notice should be included and copyright cannot be transferred in any way to the publisher;
- SPOT data and derived products, which are an integral part of remote sensing consultancy studies and reports. Copyright protection labels must clearly appear on the products and a limit of five copies can be sold to only one end user;
- slides or transparencies presented in scientific conferences used as remote sensing promotional material or illustrative material for papers;
- SPOT images or derived products exhibited in show rooms as remote sensing promotional material;
- SPOT derived works or products (any product derived from SPOT data by the addition of information external to the acquisition system and resulting in a significant modification of the data) when the modification leads to a product where the pixel structure no longer appears, e.g. line maps.

References

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"SPOT — Earth Observation Satellite" (1986) *Matra Espace.*

"SPOTLIGHT" (July 1986) *The Quarterly Newsletter of SPOT Image Corporation, Vol. 1, No. 2.*

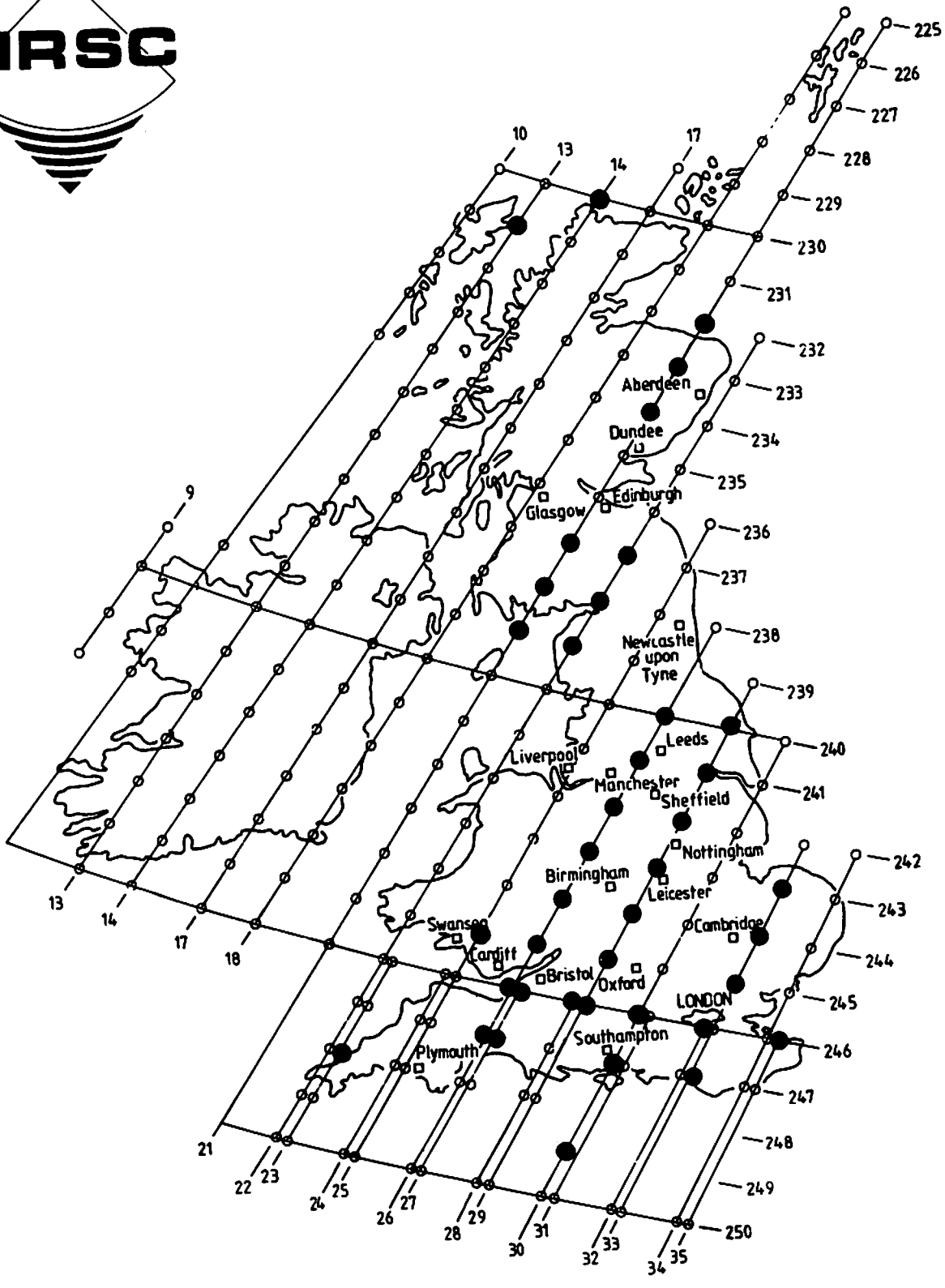
"ONBOARD EQUIPMENT — Aerospatiale Participation in SPOT" (1986) *News From Prospace, No. 25.*

"SHOOT THE EARTH — THE SKY'S THE LIMIT"
"A SATELLITE WITH TWO EYES ON THE GLOBE"
"FEARS MOUNT OVER PIRATING OF DATA FROM OUTER SPACE"
in the Financial Times, Friday 10 January, 1986.

"FRANCE PREPARES TO DEVELOP NEXT-GENERATION SPOT 4/5"
in Aviation Week and Space Technology, 20 October, 1986.

NRSC ARCHIVE MAPS AND LISTINGS

UK SPOT ARCHIVE COVERAGE MAP



UK SPOT ARCHIVE LISTING

Col	Row	Angle	Date	Sensor		Cloud	Latitude	Longitude
13	231	-2.10	24/06/86	XS	1	0101	58.25 °N	5.97 °W
14	230	2.00	24/06/86	XS	2	0010	58.71 °N	4.64°W
21	232	-2.10	30/06/86	XS	1	0701	57.80 °N	2.35 °W
21	233	-2.12	30/06/86	XS	1	0000	57.34 °N	2.62 °W
21	234	-2.12	30/06/86	XS	1	0013	56.88 °N	2.89 °W
21	237	-2.12	30/06/86	XS	1	0000	55.50 °N	3.67 °W
21	238	-2.12	30/06/86	XS	1	0000	55.04 °N	3.92 °W
21	239	-2.12	30/06/86	XS	1	0000	54.58 °N	4.17 °W
22	237	2.03	30/06/86	XS	2	0000	55.50 °N	2.73 °W
22	238	2.03	30/06/86	XS	2	0000	55.04 °N	2.99 °W
22	239	2.03	30/06/86	XS	2	0000	54.58 °N	3.25 °W
23	248	-2.12	25/06/86	XS	1	1213	50.36 °N	5.23 °W
25	245	-21.20	26/06/86	XS	1	6311	51.78 °N	4.16 °W
26	240	-2.12	15/06/86	XS	1	0000	54.12 °N	1.49 °W
26	241	-2.12	15/06/86	XS	1	0000	53.65 °N	1.73 °W
26	242	-2.12	15/06/86	XS	1	0100	53.18 °N	1.97 °W
26	243	-2.12	15/06/86	XS	1	0000	52.72 °N	2.20 °W
26	244	-2.12	15/06/86	XS	1	0000	52.25 °N	2.42 °W
26	245	-2.12	15/06/86	XS	1	0000	51.78 °N	2.64 °W
27	246	-2.12	15/06/86	XS	1	0000	51.31 °N	2.86 °W
27	247	-2.10	15/06/86	XS	1	0000	50.84 °N	3.08 °W
28	246	2.00	15/06/86	XS	2	0000	51.31 °N	2.01 °W
28	247	2.00	15/06/86	XS	2	0000	50.84 °N	2.23 °W
28	247	10.95	02/11/86	PAN	2	1000	50.84 °N	2.19 °W
28	247	-20.90	17/04/87	PAN	1	0000	50.84 °N	2.35 °E
29	240	2.00	15/06/86	XS	2	0000	54.12 °N	0.58 °W
29	241	2.00	15/06/86	XS	2	0000	53.65 °N	0.83 °W
29	242	2.00	15/06/86	XS	2	0000	53.18 °N	1.07 °W
29	242	-20.90	17/04/87	PAN	1	1514	53.18 °N	0.97 °E
29	242	-3.90	23/04/87	XS	1	0111	53.18 °N	0.70 °E
29	242	20.00	24/04/87	PAN	1	0000	53.18 °N	0.72 °E
29	243	2.00	15/06/86	XS	2	0000	52.72 °N	1.31 °W
29	244	2.00	15/06/86	XS	2	0000	52.25 °N	1.55 °W
29	245	2.03	15/06/86	XS	2	0000	51.78 °N	1.78 °W
29	246	10.95	02/11/86	PAN	2	1010	51.31 °N	1.95 °W
30	246	22.38	04/07/87	XS	2	0000	51.31 °N	0.11 °E
30	247	22.38	04/07/87	XS	2	0000	50.84 °N	1.38 °E
30	249	2.03	15/05/86	XS	2	0123	49.89 °N	1.70 °W
32	246	4.10	26/02/86	XS	1	1642	51.31 °N	0.11 °W
32	246	22.55	30/06/86	PAN	1	0010	51.31 °N	0.03 °W
32	246	22.64	30/06/86	XS	1	0010	51.31 °N	0.04 °W
33	243	-11.00	16/06/86	XS	1	0000	52.72 °N	0.63 °E
33	244	4.10	26/02/86	XS	1	1245	52.25 °N	0.35 °E
33	244	-2.10	09/04/86	XS	1	2111	52.25 °N	0.52 °E
33	244	-11.00	16/06/86	XS	1	0000	52.25 °N	0.42 °E
33	244	-10.95	16/06/86	PAN	1	0000	52.25 °N	0.44 °E
33	244	-14.60	23/09/86	XS	1	1121	52.25 °N	0.55 °E
33	245	-11.03	16/06/86	PAN	1	0010	51.78 °N	0.23 °E
33	245	-11.00	16/06/86	XS	1	1021	51.78 °N	0.23 °E
33	245	22.60	30/06/86	XS	1	0000	51.78 °N	0.23 °E
33	247	-6.30	17/07/86	XS	1	1111	50.84 °N	0.08 °W
35	246	-2.12	26/05/86	XS	1	0010	51.31 °N	1.03 °E

APPENDICES

APPENDIX 1

Ownership of SPOT

France		
CNES	(Centre National d'Etudes Spatiales)	39.0 %
IGN	(Institut Géographique National)	10.0 %
MATRA		8.8 %
SEP	(Société Européenne de Propulsion)	8.8 %
BRGM	(Bureau de Recherches Géologiques et Minières)	7.4 %
IFP	(Institut Français du Pétrole)	7.4 %
ISIS	(Société Internationale de Services Industriels et Scientifiques)	2.6 %
IRDI	(Institut Régional de Développment Industriel Midi-Pyrénées)	1.2 %
Banque Nationale de Paris		1.2 %
Crédit Lyonnais		1.2 %
Banque de Paris et des Pays-Bas		1.2 %
Valorind (Société Général)		1.2 %
Sweden		
SSC	(Swedish Space Corporation)	6.0 %
Belgium		
Belgian State (Service de la Programmation de la Politique Scientifique)		2.0 %
Belfotop Eurosense S.A. Walphot S.A. BTMC: Bell Telephone Manufacturing Company ETCA: Etudes Techniques et Constructions Aérospatiales)		2.0 %
		100.0 %

APPENDIX 2

Future SPOT Satellites

The SPOT-1 satellite was launched in February 1986 and is successfully carrying out its mission. An identical satellite, SPOT-2 has also been produced and is on-hand to replace SPOT-1 when it is required. The French Space Agency, CNES, did not want to run the risk of a premature end to SPOT-2 causing an interruption to the SPOT service, until the arrival of the new generation of SPOT satellites in the early 1990s. Therefore, it decided to produce a third satellite, identical to SPOT-1 and named SPOT-3. As CNES ordered long-lead components for this satellite in 1985, it should be ready for August 1989. Development of the next satellite, SPOT-4, will be geared to it being ready for launch in mid-1992. Optional provision has also been made for a recurrent mode of this satellite, named SPOT-5.

The Second Generation

With SPOT-4 and 5, the intention is not only to ensure the continuity of SPOT services, but also to improve them by making use of the latest advances in space technology. A number of modifications will be introduced to improve performance and increase reliability.

- **Improved Performance**

  The assessment of renewable resources is expected to derive increasing benefit from repeated satellite coverage. The CCD linear arrays selected for SPOT-4 and 5 will introduce an additional 20 m resolution channel in the mid infra-red (between 1.5 and 1.7μm), primarily for the global monitoring of vegetation. The multispectral mode of each HRV onboard SPOT-4 and 5 will thus offer four simultaneous channels with 20 m resolution. All four will be transmitted to SPOT Direct Receiving Stations at the same rate as for SPOT-1 using a data compression technique similar to that used for the panchromatic channel.

  SPOT-4 and 5 will also carry a new wide angle, low resolution imaging instrument to be located alongside the two HRVs. This instrument will generate images complementing those returned by the HRVs and will permit the continuous, frequent repeat, fast access, global monitoring of vegetation and crops. The data obtained is expected to prove most useful in assessing crop yields and vegetation status. The field of view of the new instrument will be almost 2,000 km, while resolution will be better than 1 km in each of the four HRV spectral bands offered by SPOT-4 and 5. The direct distribution of this imagery to receiving stations should prove particularly useful for regional agricultural management.

  A further improvement to be introduced with SPOT-4 and 5 will be the replacement of the 10 m resolution panchromatic mode by a mode where the spectral band B2 (0.61 — 0.68 μm) will be sampled at 10 m intervals. This means that these satellites will be able to record and directly transmit composite data with 10 or 20 m resolution by construction, ensuring excellent geometric registration between the different channels.

- **Improved Reliability**

  Several items of SPOT-4 and 5 hardware will be modified to increase both orbital lifetime and operational availability. These modifications concern the gyros and batteries, the capacity of the fuel tanks for the attitude and orbit control system, the output power of the solar array, the operating temperature of various electronics packages and so on.

  All these modifications will contribute to increasing the overall spacecraft lifetime to four years which, in turn, will make it possible to cover the period 1992 to 1998 with two satellites instead of three.

APPENDIX 3

'GRS' — Grid Reference System

The SPOT Grid Reference System, or GRS, is designed to allow for the geographic location of SPOT images. The system is used to allocate each SPOT scene a pair of scene designators (K, J) corresponding to precise geographic coordinates.

The GRS divides the globe into five zones forming a symmetrical pattern on either side of the equator as shown in the diagram below. The zones are dictated by the satellite orbital characteristics and more specifically by the convergence of the ground tracks at high latitudes:

- The Intermediate Zone, which extends from 51.5° N to 51.5° S (in latitude).
- The North and South Zones, each extending from 51.5° to 71.7° (N or S, as the case may be).
- The North Polar and South Polar zones, for latitudes above 71.7° (N or S).

The grid is made up of nodes located at the intersection of columns (K) and rows (J). In the North, Intermediate and South zones, the K columns are arranged parallel to satellite ground tracks while the rows J are parallel to the lines of latitude. The pattern of nodes within the three zones is defined in terms of satellite viewing conditions corresponding to what is known as the "twin vertical" viewing configuration. It indicates the nominal location of the centre of scenes yielded by this viewing configuration. In the case of oblique viewing, the scene centre is always located on a row J but it may not coincide (in longitude) with a GRS node.

In the two Polar zones, the GRS node pattern is independent of satellite orbital and viewing characteristics. The pattern is in fact obtained by hexagonal dissection using quasi-equilateral triangles approximately 26 km each side.

For each zone, the references K and J attributed to a SPOT scene correspond to the GRS node which is the closest to the centre of the scene.

THE GRS IN THE NORTH, INTERMEDIATE AND SOUTH ZONES

The K columns are derived in a simple manner from the SPOT reference tracks. Specifically, each track number, N, corresponds to two columns K:

K = 2N - 1 (odd number) associated with sensor one (HRV 1) and located to the west of track N.

K = 2N (even number) associated with sensor two (HRV 2) and located to the east of track N.

The distance between these two columns (i.e. between K = 2N - 1 and K = 2N) is constant at about 58 km and is a direct result of the twin vertical configuration.

The J rows are lines of constant latitude (i.e. all GRS nodes with the same J are at the same latitude). The interval between the rows has been calculated in order to ensure that there is always a minimum overlap (endlap) between two successive scenes: the scenes of a given data strip are segmented in such a way that the centres are located on two adjacent rows (J and J + 1).

In the intermediate zone, which extends from 51.5° N to 51.5° S, the GRS is comprised of 738 K columns numbered from 1 to 738 to the east, and 209 J rows numbered from 246 to 455 from north to south, resulting in 154,242 nodes.

In view of the progressively closer packing of the reference tracks as latitude increases, only two K columns out of four are maintained in the North zone (51.5° N to 71.7° N) and South zone (51.5° S to 71.7° S). In these zones, only 370 columns corresponding to odd-numbered reference tracks N are used, (though the satellite acquires imagery while following either even-numbered or odd-numbered tracks). Each North and South zone is comprised of 370 K columns and 46 J rows, numbered from 200 to 245 and from 455 to 500 respectively, from north to south, resulting in 17,020 nodes.

THE GRS IN THE TWO POLAR ZONES

The distance between adjacent nodes is constant at 26 km. In the North Polar zone, the K columns are parallel to the 120 - 300° meridian in longitude while J rows are parallel to the 60 - 240° meridian. The North Pole corresponds to K = 100, J = 100.

In the South Polar zone, the K columns are parallel to the 60 - 240° meridian and the J rows are parallel to the 120 - 300° meridian. The South Pole corresponds to K = 100, J = 600.

Each polar zone is comprised of 22,591 nodes.

APPENDIX 4

SPOT Data Distributors

Africa

South Africa
Council for Scientific and Industrial Research
P.O. Box 3718
Johannesburg - 2000

Malawi
Geoservices Limited
P.O. Box 30305
Lilongwe 3

Tunisia
Office de Topographie and Cartographie
13 Rue de Jordanie
Tunis

Ivory Coast
Société Generale de Topographie
08 BP 849
Abidjan 08

Nigeria
Danz Surveys and Consultants
24 Oyekan Road
Lagos

North America

Canada
DIGIM
1100 Boulevard Dorchester West
Montreal, Quebec H3B 4P3

Canada
Canada Center for Remote Sensing (CCRS)
2464 Sheffield Road
Ottawa K1A 0Y7

United States
SPOT Image Corporation
1897 Preston White Drive
Reston, Virginia 22091

Latin America

Argentina
Centro Nacional de Investigaciones Espaciales
Centro de Teleobservacion
Av. del Libertador 1513 Vincente Lopez 1638
Buenos Aires

Bolivia
Centro de Investigacion Y Aplicacion de
Sensores Remotos
Casilla de correo 2729
La Paz

Mexico
Instituto Nacional de Estadistica Geografia
E Informatica
San Antonio ABAD 124
Mexico 8 DF

Venezuela
Fundacion Instituto de Ingeneiria
Edo Mirando Apartado 40200
Caracas 1040 A

Brazil
Sensora
Avenida Semambetiba NR 4446
Rio de Janeiro CEP 22600

Chile
Servicio Aerofotogrametrico de la
Fuerza Aerea
Casilla 67 correo los cerillos
Santiago

Peru
Oficina Nacional de Evaluacion de
Recursos Naturales
355 calle 17, Urb El Palomar-San Isidro
Lima

Brazil
INPE
Av. dos Astronautas, 1758
CEP 12200
Sao Paulo

Asia

Japan
Remote Sensing Technology Center (RESTEC)
Uni Roppongi Bldg 7-15-17 Roppongi
Minato Ku
Tokyo 106

Nepal
National Remote Sensing Center (NRSC)
P.O. Box 3103
Kathmandu

Taiwan
Center for Space and Remote Sensing Research
National Central University, Chung-Li
Taiwan 320

Peoples Republic of China
Space Science and Technology Center
Chinese Academy of Science
Peking

Pakistan
S.U.P.A.R.C.O.
P.O.Box 3125
Karachi

Malaysia
Terra Control Technologies Sdn. Bhd
Godown 3, Banguman Nupro
Jalan Brickfield
50470 Kuala Lumpur

The Philippines
Natural Resources Management Center
P.O. Box AC
Quezon City 493

Thailand
National Research Council (NRC)
196, Phahonyothin Road
Bangkok 10900

India
National Remote Sensing Agency
Department of Space
Balanagar
Hyderabad 500 037 AP

Japan
NASDA
Programme Planning and Management
Department, 2-4-1, Hamamatsu-Cho
Minato-Ku, Tokyo 105

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Austria
Beckel Satellitenbilddaten
Marie-Louisen Strasse
Bad Ischl 4820

Denmark
Plancenter Fyn A/S
Overgade 32
5000 Odense C

Finland
National Board of Survey (NBS)
Pasilan Virastukeskus Opastinsilta
12 Helsinki 52 00521

United Kingdom
National Remote Sensing Centre
Space Department, RAE
Farnborough
Hants. GU14 6TD

Eire
E.R.A.
Remote Sensing, Geological and
Environmental Services
Environmental Resources Analysis Limited
187, Pearse Street
Dublin 2

Belgium
Services de la Programmation de la
Politique Scientifique
8, Rue de la Science
1040 Brussels

Spain
Instituto Geografico Nacional (IGN)
General Ibanez de Ibero, 3
Madrid 3

United Kingdom
Nigel Press Associates Ltd
Edenbridge
Kent TN8 6HS

Hungary
Foldmeresi Intezet
Guszev v. 19
Budapest H 1051

Italy
Telespazio
Département Commercial
Via Alberto Bergamini, 50
Rome 00159

Norway
Fjellanger Widerøe A/S
P.O. Box 2916
Trondheim 7001

The Netherlands
Nationnal Lucht-en
Ruimtevaartlaboratorium (NLR)
P.O.Box 90502
BM Amsterdam 1006

Poland
Geokart
2/4 Rue Jasna
Varsovie 00-950

Portugal
Geometral
Ave. Cons. Barjona de Freitas
No. 20-A
1500 Lisbon

West Germany
Deutsche Forschungs-und Versuchsanstalt
Fur Luft Und Raumfarht (DFVLR)
Oberpfaffenhofen
Wessling 8031

Sweden
Satimage
P.O.Box 816
28 Kiruna S-981

Switzerland
Bundesamt Fur Landestopographie
Seftigenstr. 264
CH-3084 Wabern

Yugoslavia
Rudarski Institut Beograd
Remote Sensing Department
Batajnicki put 2
11081 Zemun

Middle East

Egypt
Remote Sensing Centre
101, Kasr El Eini Street
Cairo

Israel
Interdisciplinary Center for Technological
Analysis and Forecasting (ICTAF)
Ramat-Aviv
Tel-Aviv 69978

Saudia Arabia
King Abdulaziz City for Science and Technology
P.O. Box 6086
Riyadh 11442

South Pacific

New Zealand
Department of Scientific and Industrial Research
Bell Road
Private Bag
Lower Hutt
Wellington

Australia
NATMAP
Division of National Mapping
P.O. Box 31
Belconnen, ACT 2616

APPENDIX 5

STANDARD SPOT PRODUCTS PRICE LIST

The National Remote Sensing Centre (NRSC) is a focal point for the development and application of remote sensing techniques in the UK. As one of its roles the NRSC offers an ever-expanding range of products to all users of satellite remote sensing data. This price list outlines the standard range of NRSC SPOT products, for other products, including those supplied directly from SPOT Image, you should contact the NRSC for price details.

DIGITAL PRODUCTS

Computer compatible tapes (CCTs) are supplied on 6250 or 1600bpi phase encoded 3600ft tape. They are available in SPOT ground station format or in an enhanced RAE format. The standard digital product is SPOT Level 1B (radiometric and geometric system corrections). A single scene CCT contains three bands of the 20m multispectral (XS) data or a single band of 10m panchromatic (PA) data. When ordering digital data you should specify your requirements for Tape Density, Tape Format and Data Type.

Product	Product Fee	Royalty Fee	Price (Exc. VAT)
Full scene PA or XS 6250 bpi	£395.00	£306.00	£701.00
Full scene PA or XS 1600 bpi	£425.00	£306.00	£731.00

N.B. *Listed products and prices are for data held in NRSC archive*

PHOTO PRODUCTS

A comprehensive range of photographic products prepared from black and white or colour masters are available. The prices listed below are for full scenes (60x60km), however at the present time the NRSC is unable to generate black and white products wider than 5000 pixels (in this mode full scenes vary between 6000 and 10400 pixels per line depending on angle of view and the pre-processing level) The prices assume the original master has been generated and in some cases this cost must be added to the order.

Product Code	Product Type	Scale	Nominal Size	Product Fee	Royalty Fee	Price (Exc.VAT)
P/SX/2	B&W Print	1:500,000		£20.50	£30.60	£51.10
P/SX/4	B&W Print	1:250,000		£37.25	£30.60	£67.85
P/SX/10	B&W Print	1:100,000		£61.00	£30.60	£91.60
P/SX/B	B&W Print	Unscaled	500 mm	£37.25	£30.60	£67.85
P/SX/C	B&W Print	Unscaled	1000 mm	£61.00	£30.60	£91.60
FN/SX/2	B&W Film Neg	1:500,000		£170.00	£56.10	£226.10
FP/SX/2	B&W Film Pos	1:500,000		£170.00	£56.10	£226.10
P/SP/2	B&W Print	1:500,000		£20.50	£81.60	£102.10
P/SP/4	B&W Print	1:250,000		£37.25	£81.60	£118.85
P/SP/10	B&W Print	1:100,000		£61.00	£81.60	£142.60
P/SP/B	B&W Print	Unscaled	500 mm	£37.25	£81.60	£118.85
P/SP/C	B&W Print	Unscaled	1000 mm	£61.00	£81.60	£142.60
FN/SP/2	B&W Film Neg	1:500,000		£170.00	£163.20	£333.20
FP/SP/2	B&W Film Pos	1:500,000		£170.00	£163.20	£333.20
CP/SX/2	Col. Print	1:500,000		£38.00	£86.70	£124.70
CP/SX/4	Col. Print	1:250,000		£63.00	£86.70	£149.70
CP/SX/10	Col. Print	1:100,000		£159.00	£86.70	£245.70
CP/SX/B	Col. Print	Unscaled	500 mm	£63.00	£86.70	£149.70
CP/SX/C	Col. Print	Unscaled	1000 mm	£159.00	£86.70	£245.70
CFN/SX/2	Col. Film Neg	1:500,000		£250.00	£163.20	£413.20
CFP/SX/2	Col. Film Pos	1:500,000		£94.50	£163.20	£257.70

(SP) denotes PANCHROMATIC **(SX)** denotes MULTISPECTRAL

N.B. *Sizes are not quoted for scaled SPOT products as physical size is dependent upon the LOOK ANGLE. Prices are inclusive of postage and packaging, but exclusive of VAT and any import charges that may be levied.*

NOTES

1. Certain fees, e.g. the CCT prices and the royalty fees are directly linked with the SPOT Image Price List and the FF/£ exchange rate - if the exchange rate changes markedly it may be necessary to amend product prices.

2. Precision products (Levels 2 and S) will be charged according to the work content and computer input involved in their generation. They will be prepared strictly to SPOT Image standards and will generally be acquired directly from SPOT Image.

3. With the exception of Level 1A products paper sizes may limit the scales/enlargement of prints to low and moderate off-nadir viewing angles.

4. Quarter scenes may also be available consisting of the four quarters plus an equivalent central area - there will be a 10% overlap between these quarter scenes.

5. SPOT royalties charges on part scenes will be charged at a percentage of the appropriate full scene fee, as follows:

part scene size	**% of royalty fee charge**
> quarter of scene	100%
quarter to one-sixteenth of full scene	27%
less than one-sixteenth of full scene	5%

NRSC SERVICES

Interactive Image Analysis

The NRSC has two GEMS image analysis systems permanently available for hire to any outside user, and additional back-up systems can be used to meet peak demand. GEMS is operated by a user-friendly package called GEMSTONE and the system has been designed to handle current and future satellite data, airborne scanner imagery and digitised aerial photographs and maps.

Hard copy output is possible via an on-line camera system or for higher quality photographic data, interactively processed imagery can be written to film on the Spectrascan laser writer.

	Product Fee	**Royalty Fee**	**Price (Exc. VAT)**
GEMS interactive image processing system			
(charge exclusive of CPU time) hourly rate	-	-	£27.50
use of imagery - load charge per CCT requested	£12.75	£5.10	£17.85
On-line camera output:			
35mm colour slides (36 exposures)	£12.75	£5.10	£17.85

COPYRIGHT

Copyright restrictions apply to all SPOT data. SPOT data may not be disseminated in any form without the written consent of the copyright holder and payment of the appropriate royalty fee. For further information please contact the NRSC.

The NRSC aims to be responsive to the needs and requirements of remote sensing data users and enquiries concerning special products, both digital and photographic, are welcomed. Individual cost estimates will be prepared for such items. Special promotional prices may apply to NRSC products derived from UK imagery held within the NRSC archive.

For further information on any aspect of the NRSC please contact:

National Remote Sensing Centre
Space Department, Royal Aircraft Establishment
Farnborough, Hants GU14 6TD

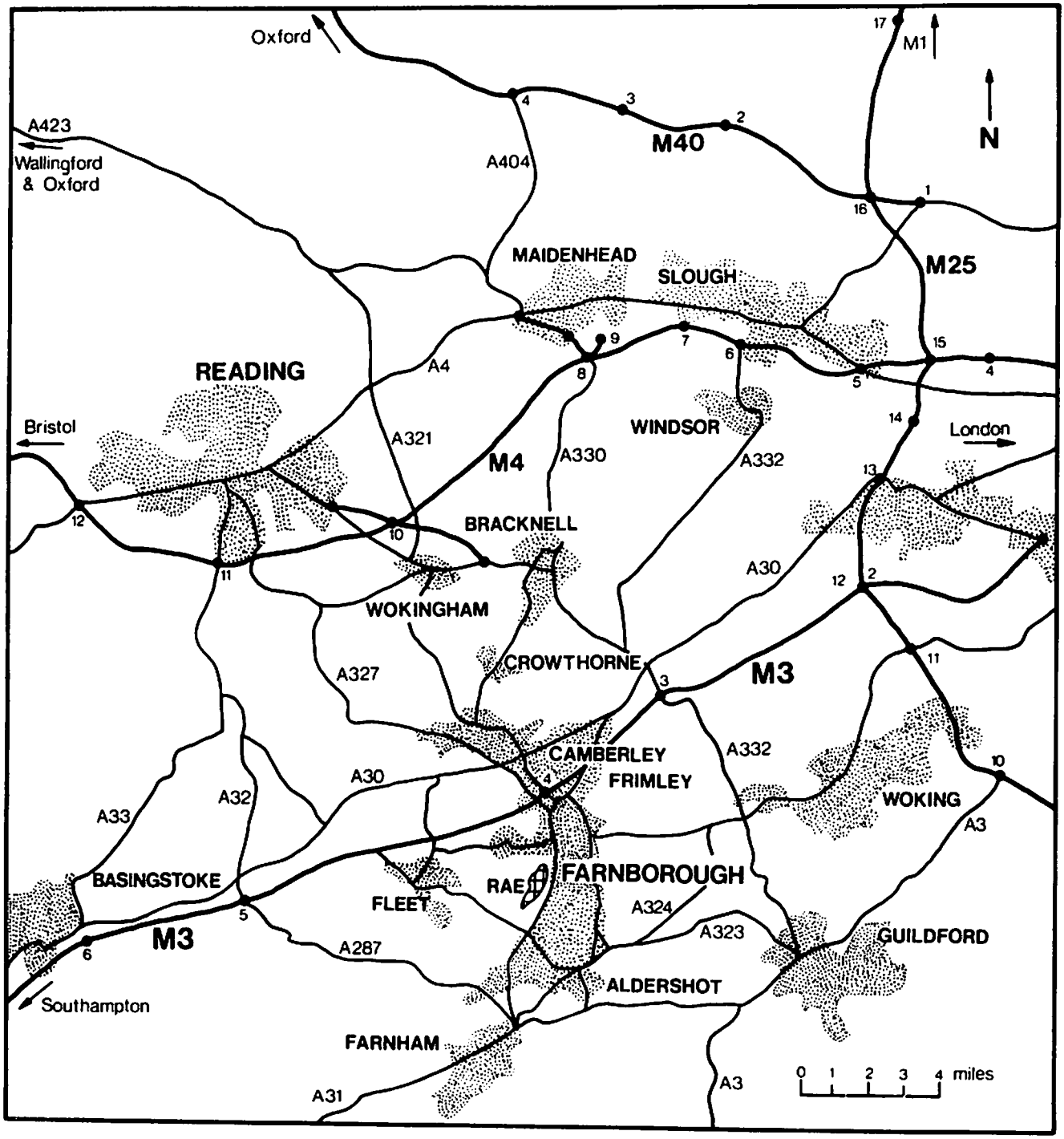
Telephone: (0252) 541464
Telex: 859891

Prices are quoted in sterling and are inclusive of postage and packaging, but exclusive of VAT and any import charges which will be added to all accounts at the appropriate rate.

APPENDIX 6

NRSC

LOCATION MAPS FOR THE ROYAL AIRCRAFT ESTABLISHMENT AND THE NATIONAL REMOTE SENSING CENTRE

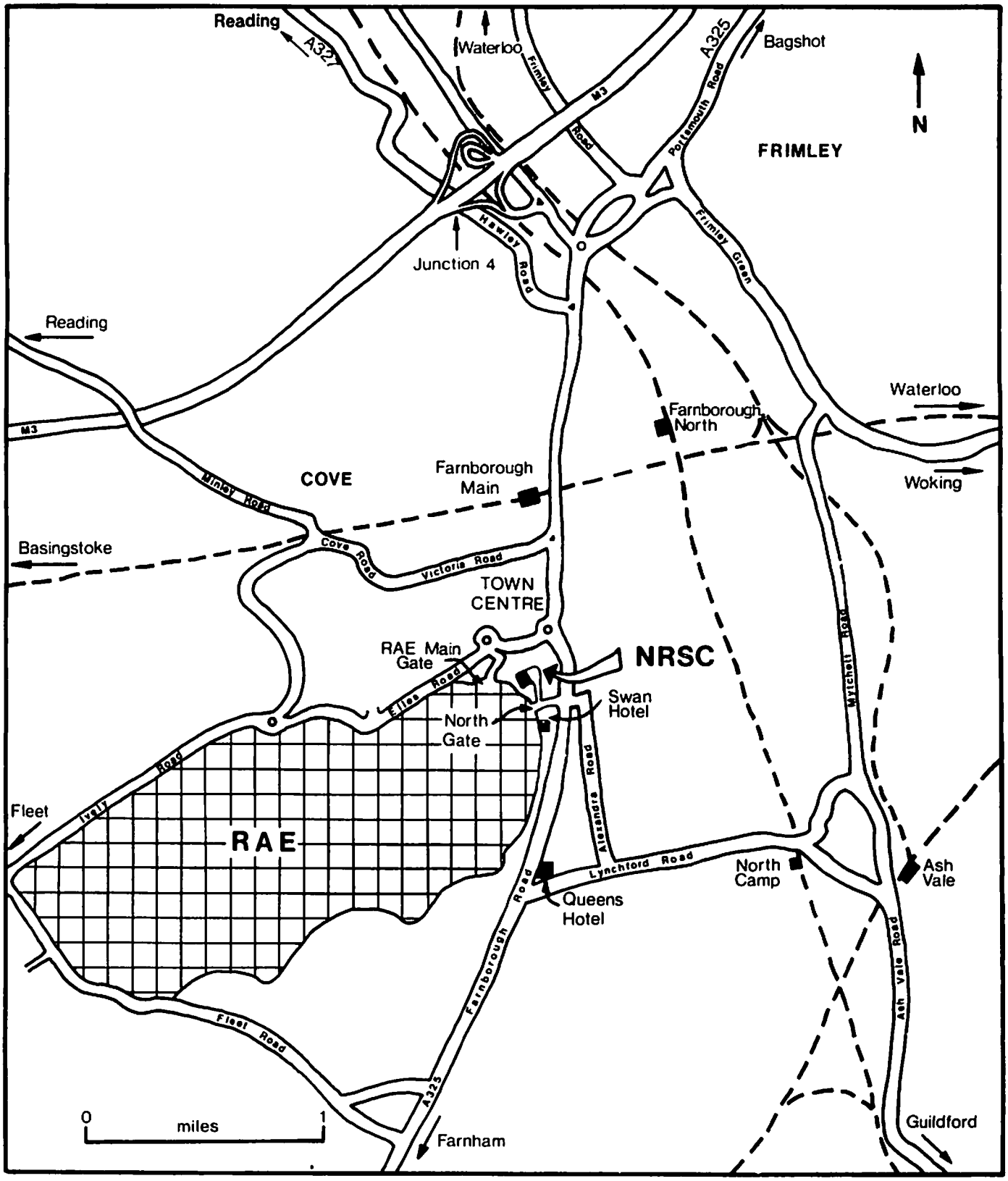


Train services:

From Waterloo - Farnborough Main (Basingstoke line) half-hourly service
- Ash Vale (Aldershot and Alton line) half-hourly service

From Basingstoke and the West - Farnborough Main

From Reading or Guildford - North Camp and Farnborough North



Directions to the National Remote Sensing Centre

At the traffic lights on the A325 approach RAE North Gate entrance. **DO NOT** enter the Royal Aircraft Establishment, but turn right into the North Gate Car Park. Go straight through the Car Park and follow the signs to the National Remote Sensing Centre.

APPENDIX 7

NRSC MAIL-LIST FORM

The National Remote Sensing Centre (NRSC) is a focal point for the development and application of remote sensing techniques in the UK. If you would like your name added to our mailing list to receive our latest publications on a regular basis, please complete and return this form.

Surname: ..... **Initials:** ..... **Title** (Prof, Dr, etc.): .....

Job Title: .....
Department: .....
Organisation: .....
Address: .....
.....
Town/City: .....
County/State: ..... **Postal Code:** .....
Country: .....
Telephone No.:..... **Telex No.:** .....

Please mark applicable box to describe your organisation type or mark individual:-

☐ Government ☐ Commercial ☐ Academic ☐ Other ☐ Individual

Please identify the publications you wish to receive:-

☐ **Newsletter** ☐ **Introductory Guide to the NRSC** (new/infrequent data users)

☐ **General Interests Products Catalogue** ☐ **Data Users Guide** (NRSC customers)

Please mark as many of the disciplines listed below as appropriate to adequately describe your present or potential involvement with remote sensing:-

☐ Agriculture and soils
☐ Land use/cover
☐ Forestry
☐ Geology
☐ Terrain analysis
☐ Coastal processes
☐ Oceans
☐ Hydrology
☐ Ice/Glaciology
☐ Environmental quality
☐ Meteorology
☐ Education and training
☐ Satellite technology
☐ Sensor technology
☐ Data processing techniques
☐ Information handling techniques
☐ Geographic Information Systems

Sensor types:-

☐ Landsat ☐ SPOT ☐ NOAA ☐ ERS-1

NRSC use only:

Coding:

Please return this form to:-
Mrs M Y Ames
National Remote Sensing Centre
R190, Space Department
Royal Aircraft Establishment
Farnborough, Hants, GU14 6TD, UK
(Telephone: 0252 541464)

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